LENDING BEHAVIOR OF MULTINATIONAL BANK AFFILIATES

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Abstract

We study the parent influence on lending by affiliates of a multinational bank. In the proposed theoretical model, local lending is influenced by shareholder-affiliate manager delegation and precautionary motives. The outcome is either contagion (the loan volume in the affiliate follows the direction of the parent bank country shock) or performance-based reallocation of funds (substitution), depending on the degree of manager delegation in the affiliate and the liquidity-sensitivity in the parent bank. Empirical investigation, deliberately conducted on a sample not covering the latest financial crisis, shows that also in "normal" times, multinational banks that are likely to delegate lending decisions or be more liquidity-sensitive are more inclined towards contagionist behavior.

Keywords: Multinational bank; Delegation; Agency; Substitution; Contagion

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1. Introduction

Many open economies exhibit high levels of multinational bank (MNB) penetration. Therefore, cross-border shock transmission by an MNB, besides being important from a purely academic point of view, is a major policy concern. As the global financial crisis has demonstrated, the involvement of prominent international bank groups in toxic investment products can create a credit crunch in completely unrelated economies. However, due to the existence of MNBs, the link between loan quality changes in one country and credit creation in another is not limited to times of crisis, so that our analysis is not preoccupied with the events of 2007-10 but with an earlier "regular" period. Bank regulators in a parent bank's country of incorporation (hereinafter the *home country*) are always preoccupied with destabilizing spillovers on it from foreign country units. This is not surprising given that MNBs are usually among the leading, systemically important banks on the national level. For similar reasons, some MNBs suffered rating downgrades when considered "overstretched" by foreign bank acquisitions. On the other hand, policymakers in countries where MNBs operated (hereinafter *host countries*) always have reasons to fear that a shock affecting the parent bank, although it had nothing to do with the domestic economic or financial fundamentals, may distort lending decisions within their jurisdiction, the effect growing with the degree of foreign-bank penetration.

This paper does not study the reasons for foreign bank penetration nor does it explore the causality between foreign bank presence and the real economy (e.g. business cycle, as in Morgan et al., 2004). Instead, we look for the probable causes and empirical relevance of shock transmission from a parent bank's loan returns and economic conditions in its home country to lending by its foreign affiliate (*cross-border lending spillover*). To the best of our knowledge, this is novel in both the theoretical and, in many aspects, also the empirical banking literature.

Interdependence of investment decisions can be studied for any multinational financial institution, but the case of banks is specific. Namely, units in different countries predominantly lend to local customers and are also managed locally. But then, why should the performance of one country unit (particularly the parent bank) be relevant for fund allocation in another? Given that commercial bank assets are for the most part nontradable, the rationale for lending spillover in an MNB is not as readily available as for cross-border contagion in securities markets. At first glance, there should be less cross-border spillover in a bank than in a secondary security market. However, credit provision by many foreign-owned banks cannot be fully explained by local driving factors. Multinational banks often cross-subsidize between different country units in reaction to changes in loan quality in one country. For an outside observer, the effect looks like cross-border lending contagion.[18] This observation served as an impulse for the present analysis.

In the standard portfolio-optimization theory, cross-border spillovers happen since a shock to the asset-return pattern in one country induces wealth reallocation across divisions in different countries (in particular, when expected returns are subject to a shock, the observed reallocation will be called substitution). The optimal home-host country fund split is influenced by the presence of frictions. The two frictions we analyze in detail are management delegation in the affiliate and sensitivity to the threshold value of liquid wealth that triggers termination (such as a bank run, regulatory intervention, or a takeover with reorganization) in the parent.

The agency problem caused by delegation is a known element in the internal capital market literature (Scharfstein and Stein, 2000). The termination threshold influence has its origins in the real option theory (Dixit and Pindyck, 1994), although in our setting it is stripped of its usual continuous-time garment and adapted to the bank-specific set-up. We demonstrate that spillover from loan performance in the parent bank to lending volume in the affiliate is a generic property of a rational MNB and will typically be stronger in more liquidity-sensitive banks. The named MNB-specific frictions are able to shift the rational reaction to shocks from substitution to contagion, i.e., loan volumes in the affiliates tend to move in the same direction as the condition of the parent. These findings are robust with respect to reasonable generalizations of the model as to organizational form and manager autonomy.

These theoretical results serve as a justification for an empirical model in which parent bank performance joins the list of more traditional explanatory variables of affiliate lending growth. We then test for the systematic presence of either lending contagion or substitution in a large sample of MNBs in industrial countries.[19] Exploiting a comparison of the modeled bank with a frictionless benchmark investor, we argue that for the period and set of host countries studied, the direction of parent bank influence corresponds to the lending contagion in MNBs under liquidity-sensitivity or affiliate management delegation. In the estimated equation, the two mentioned frictions are summarized by a binary indicator variable, the *Affiliate Friction Indicator*, which is interacted with regressors capturing parent and affiliate bank performance. In this way, we test, in the presence of several traditional controls (home and host country fundamentals), our prior about the intra-MNB agency determinants of cross-border spillovers. The Affiliate Friction Indicator turns out to be a significant explanatory variable of affiliate lending volume growth, and the coefficient sign is as expected under the contagionist type of cross-border lending spillover.

The rest of the paper is organized as follows. Section 2 embeds our work in the related literature and explains how the present paper develops it. Section 3 introduces the theoretical model, Section 4 presents the panel regression results for our empirical model of multinational bank lending, and Section 5 concludes. Formal aspects of the theoretical model are covered by the Appendix.

2. Related literature

The theory of MNBs' behavior is not particularly well developed, but some branches of the financial intermediation literature provide tangency points with our modeling approach. In the area of cross-border risk transmission, Chan-Lau and Chen (2002) derive the dependence of a reversal in the credit supply in an open economy on the extent of frictions in the financial sector relative to the economic fundamentals. Stein (1997), and Froot and Stein (1998) provide a unified treatment of bank capital budgeting in the presence of external and internal capital markets. Scharfstein and Stein (2000) demonstrate how the workings of an internal capital market can lead to "socialist" redistribution of an investment budget from a stronger to a weaker division (further developed in Bernardo et al., 2006). This result could be reinterpreted as contagion in our setting (the MNB CEO, instead of increasing the funds of a well-performing affiliate, supports weak ones consolidated with the parent bank).

The theory of banks developed in Diamond (1984) and Diamond and Rajan (2000, 2001), describes twin principle-agent phenomena: between the bank manager and the borrower (induced by non-

[18] The term "contagion" here refers to both positive and negative developments, meaning better/worse performance in the parent inducing more/less lending in the affiliate. So, some foreign bank affiliates forego business opportunities for years in markets with a lot of potential, while others undertake ambitious expansion programs despite downturns and crises in the host country.

[19] We have in mind both standard organizational forms of foreign-bank presence: branches and subsidiaries. For our purposes, the most important feature is the existence of a centralized alternative to localized management, whereas the existence of a separate legal entity (subsidiary) plays a subordinate role. In this way, we acknowledge two widespread stylized facts of foreign-owned bank activities: overcapitalization (i.e., slack regulatory capital constraints) and the gradually increasing weight of branch-based presence. Both observations indicate that legal structure may not be the prime factor of relevance.

tradability and borrower-specific information asymmetry), in which the manager is the principal; and between the shareholder and the manager (due to unobservable manager effort), in which the manager is the agent. Both agency effects are easily extended to the MNB case, and are implicitly present in the background of own model. An example of explicit local manager incentive modeling in an MNB can be found in Külpmann, 2000.

Morgan et al. (2004) combine an empirical investigation of cross-border lending spillovers with a formal optimization model. That paper studies the real implications of removed inter-state branching restrictions on commercial banks in the U.S. The focus there is on the significance of inter-state financing for borrowers. Since the objective of the borrower in Morgan et al. (2004) is to get the most advantageous financing terms from the bank – either within- or out-of-state – which is best equipped to provide it, the effect on the bank side that this model produces is similar to our substitution effect. So, that model, by construction, cannot be used directly to address contagion as an intra-bank phenomenon. Ours can be considered a complement to the above, dealing with the loan supply side, whereas the emphasis of Morgan et al. (2004) is on the demand side.

Empirical studies of various macro- and micro- lending volume determinants in MNB affiliates include de Haas and van Lelyveld (2004, 2006a) for Central and Eastern Europe and de Haas and van Lelyveld (2006b) on a global scale. Affinities with our work exist both in the subject and in the data used (bank-level financial characteristics taken from BankScope, home and host country economic fundamentals). The main conceptual difference is our explicit decision-theoretic foundation for an MNB-internal capital market which rationalizes both substitution and contagion. Furthermore, our empirical analysis adds two novel dimensions: the already mentioned loan portfolio performance of the parent bank and the home-host country exchange rate volatility. We conjecture that exchange rate volatility should be a suitable summary statistic of several risk factors that influence parent support for dependent units in an MNB. The exchange rate volatility turns out to be significant unless other controls pick up these risks themselves. The relative roles of the individual explanatory variables will be clarified by the exposition of the model in the next section.

3. A model of a multinational bank with delegated foreign affiliate management

3.1 Theoretical background

Inspired by the Froot and Stein (1998) approach we draw a parallel between projects in which a bank invests, in their model, and the affiliates to which an MNB allocates a budget, in our own. Decisions about allocating funds in different countries by an MNB, as by any other international investor, would be mutually dependent in any model containing optimization of an international portfolio. Under our approach, an MNB differs along two dimensions.

First, since it is a bank, there exists a termination trigger which distinguishes it from other types of investors. Its investments are funded by deposits along with shareholder capital. If earnings are insufficient to compensate for the withdrawal of deposits, the liquid wealth (disposable funds) falls below a given threshold and the bank fails (which can mean a depositor run, forced administration or other forms of activity termination and removal of shareholder rights).

Second, MNB returns on lending in a particular country can be enhanced by putting country-specific expertise to work. We give the shareholder the opportunity to delegate the operation of a foreign affiliate to a local manager in possession of non-transferable human capital. The affiliate manager acts in a relationship-banking environment and is more successful in collecting on debt because of his knowledge about the repayment ability of the set of borrowers that comprise the local loan portfolio. Without the local manager, the shareholder would have to run the affiliate at arm's length (for lending decisions, this would mean applying some standardized rule-based procedure for loan application processing without recourse to any "soft" knowledge about the borrowers). The manager is remunerated by a fee paid out of the affiliate's proceeds. Arm's length management by the shareholder would save on the fee, but result in losing a part of the potential returns. More generally, the parameters of the loans granted by the shareholder acting in the affiliate on her own would be different from the ones following from the manager's decisions. We will call the hypothetical lending volume in that case the shareholder's *replacement lending choice*, and the maximal utility thus attained her *replacement utility*. These quantities characterize the shareholder's outside option in the bargaining game with the affiliate manager.[20]

[20] To the best of our knowledge, the concept of replacement (i.e., out-of-equilibrium) return-on-investment distribution as a determinant of equilibrium investment properties has not been sufficiently explored in the financial intermediation literature, and the internal capital market literature in particular. Models like Scharfstein and Stein (2000), as well as many related ones, derive investment distortions from

Differently from Scharfstein and Stein (2000), we embed the agency effect of delegation in an otherwise conventional optimal portfolio selection and risk hedging decision of the bank. This, among other things, allows one to make comparisons with the standard no-friction investment paradigm that we extend to account for the specifics of banks related to their sensitivity to termination risk such as a depositor run or a preemptive regulatory intervention.[21] The roles of both manager-specific human capital and run threat are defined exogenously and the agency-theoretic dimension of the manager-borrower interaction is present in the background.

The previously defined MNB-specific frictions transmit into deviations of the lending process in the affiliate from a hypothetical frictionless benchmark. So, a convenient way to express the dependence of the affiliate loan volume on the parent performance is in terms of the decisions of a simple *frictionless investor*. This is a plain international portfolio certainty equivalent-optimizer without either binding liquidity or short-sale constraints. One can think of the host country loans collected in a special-purpose vehicle (SPV) in whose liabilities this investor trades, and there is no delegation of host country portfolio management. (Accordingly, the frictionless investor can only earn replacement returns.) The frictionless investor neither collects deposits (in any country) nor faces a regulatory termination boundary. The frictionless investor portfolio diversification gives rise to cross-border spillovers only for conventional hedging reasons. The spillover can go in the direction of both substitution and contagion, depending on the joint distribution of returns. Since this type of investment is unobservable, we will only use it as a point of reference, to find out whether the lending spillover shifts in the direction of substitution or contagion when the MNB-specific frictions are introduced.

Formally, the parent bank and its home country influence lending behavior in the affiliate through the manager's fee. This fee appropriates (most of) the surplus from the earnings the manager delivers in excess of what the bank shareholder could do by direct involvement in the affiliate. Since the shareholder arm's length returns might have non-zero correlations across countries (e.g. due to common noise components, exchange rate volatility, etc.), the affiliate manager's lending decisions that maximize his fee are also influenced by variables outside his country of operation. Cross-border spillovers arise because the manager, while investing locally, is forced to think globally. To develop the intuition, consider an example in which the shareholder extracts higher/lower returns under an arm's length operation abroad at the same time as at home, whereas the hired manager's performance in the foreign unit is completely independent of the parent bank performance. Then, in the "low return state of nature" the shareholder earns less abroad in net terms due to the high fee paid to the manager. The foreign affiliate may then obtain a low budget. Therefore, in this state of nature, a loan volume reduction both at home and abroad is likely and lending contagion materializes. As we show in the rest of this section, the phenomenon of lending contagion is much more general than that.

3.2 Formal set-up

There are two countries, home, in which an MNB is incorporated, and host, in which this bank has an affiliate. The home country currency unit is the numéraire. To avoid additional complexity, we do not model exchange-rate risks in detail.[22] There is one general investment opportunity (global portfolio) and another opportunity to grant loans in each of the two countries. There are also risk-free money-market deposit opportunities in both countries. Each country unit attracts a fixed amount of deposits. The representative bank shareholder has a fixed amount of capital to invest. Shareholder funds and deposits are invested in either of the aforementioned assets. There are two periods, the first when the capital allocation, deposit collection, and lending take place, and the second when returns are realized and interest and fees are paid. Some deposits may be withdrawn in the second period due to an unspecified liquidity shock. The uncertainties in the first period exist with regard to: returns on loans, returns on outside assets (exchange rate-adjusted in the case of the host country), and the deposit-withdrawal rates in both countries. The shareholder is a risk-averse expected-utility maximizer.

The manager is able to earn a mean rate of return z^l on the loans in excess of the basic arm's-length rate z^s that can be extracted from the same borrowers by the shareholder who decides to operate the affiliate at arm's length, as well as any outside investor. The manager's unique earning ability is the source of his bargaining power. This feature

exogenous managerial rent-seeking motives. We do not need the latter, since our distortions result from a gap between earnings with and without delegation.

[21] The term liquidity-(in)sensitive banks is used subsequently instead of termination-(in)sensitive to avoid the possible failure connotation that might be associated with the latter term. Throughout the considered period (unlike the one that started in summer 2007), the MNBs in our sample were sound and solvent. So, our model does not refer to the standard distance-to-default value, nor is the validity of the results restricted to MNBs close to default. Rather, we work with a volatility-adjusted hypothetical threshold of wealth values below which the MNB shareholder utility curving downwards first becomes visible. Formal definitions are given in Subsection 3.2.

[22] See Assumption A1 in the Appendix and the discussion thereafter.

distinguishes our model from many others in the internal capital market literature, most notably Scharfstein and Stein, 2000, who impose at least some bargaining power of the principal. In our view, when the agent's non-transferrable skills are involved, it is much more natural to explore the bargaining power of the latter. This idea is reflected in the following assumption.

Assumption 1 *The affiliate manager has full bargaining power over the parent bank shareholder, so that he negotiates a fee such that the shareholder's utility achieved with the help of his services is equal to her replacement utility plus one cent. In other words, the shareholder is indifferent between keeping and dismissing the manager.*

Any fee higher than the one defined in Assumption 1 would be suboptimal for the shareholder, who would do better acting in the manager's place herself. A lower fee would be suboptimal for the manager unless he was exposed to competition from others with human capital linked to the same loan portfolio, which is highly improbable. Assumption 1 is just one of the many existing ways to describe the shareholder-manager negotiation outcome, which was chosen as a likely one in a relationship-banking environment.[23] This choice also contributes to computational tractability.

The shareholder-manager interaction in period 0 is defined as a simultaneous-move game whose equilibrium is described in the Appendix.

3.3 Optimal policies and parent-affiliate lending spillover

We denote by W the MNB's end-of-period wealth under delegated affiliate management, and by $\tilde{W}$ its replacement end-of-period wealth (i.e., no delegation). Both are random variables, with means μ and $\tilde{\mu}$ and standard deviations σ and $\tilde{\sigma}$, respectively. (Variables with tildes always refer to the replacement case.) Further, let γ be the MNB shareholders' absolute risk aversion parameter and W^0 the termination threshold for the MNB's wealth. The MNB's utility will be the expected negative exponential of the terminal wealth adjusted for the possibility of termination. In the latter case, the shareholder benefit is reduced to zero. Formally, for the delegation and non-delegation cases,

$$U = E\left[\left(e^{-\gamma W^0} - e^{-\gamma \mathbf{W}}\right)\mathbf{1}_{\{\mathbf{W}\geq W^0\}}\right],$$
$$\tilde{U} = E\left[\left(e^{-\gamma W^0} - e^{-\gamma \tilde{\mathbf{W}}}\right)\mathbf{1}_{\{\tilde{\mathbf{W}}\geq W^0\}}\right],$$

where $\mathbf{1}_{\{\mathbf{W}\geq W^0\}}$ is the indicator function of the corresponding random event. That is, the utility is cut-off at the level of zero if the realization of the terminal wealth random variable $\mathbf{W}$ ($\tilde{\mathbf{W}}$ in the replacement case) falls short of W^0.

For future use, we introduce the following auxiliary parameters. Let $CE = \mu - \frac{\gamma}{2}\sigma^2$ be the usual certainty-equivalent of the mean wealth ($\tilde{CE}$ in the replacement case is defined analogously). The sensitivities of utility to the wealth mean μ and variance $v=\sigma^2$ changes are defined as

$$M = e^{\gamma CE}\frac{\partial U}{\partial \mu},\ V = -\frac{2}{\gamma}e^{\gamma CE}\frac{\partial U}{\partial v}.$$

Symbols $\tilde{M}$ and $\tilde{V}$ will be used for the corresponding sensitivities of the replacement utility $\tilde{U}$. The Appendix features the exact formulae for these functions. We use the shorthand Θ for the ratio $\tilde{M}/\tilde{V}$. This parameter measures the marginal rate of substitution between the mean wealth and its riskiness, under replacement management. The range of Θ-values is between zero (as one approaches the termination boundary) and unity (when the distance to termination becomes large).

To characterize liquidity-sensitivity, we define the risk-adjusted distance to termination as

$$T = \frac{\mu - W^0 - \gamma\sigma^2}{\sigma},\ \tilde{T} = \frac{\tilde{\mu} - W^0 - \gamma\tilde{\sigma}^2}{\tilde{\sigma}}$$

for the delegation and non-delegation cases, respectively.

Denote by N the standard normal cumulative distribution function. Given the normality assumption it is straightforward to show that

$$U = e^{-\gamma W^0} - N(T)e^{-\gamma CE},$$
$$\tilde{U} = e^{-\gamma W^0} - N(\tilde{T})e^{-\gamma \tilde{CE}}.$$

When the distance to termination is sufficiently big, the bank shareholder preferences are almost the same as those of an unconstrained investor, and the utility is the standard negative exponential of the certainty equivalent of future wealth. As the distance to termination decreases, the expected utility, as it approaches zero, falls short of the certainty-equivalence benchmark, and the shortfall is non-linear. The corresponding curvature starts influencing the shareholder's choices long before the expected wealth itself approaches the termination level.

[23] Alternatively, in Diamond and Rajan (2000), the bargaining power is split at random between the shareholder and the manager, each of them given, with probability ½, the right to make a take-it-or-leave-it offer to the other. More generally, a Nash bargaining solution with a non-trivial division of negotiation power between the shareholder and the manager can be obtained in our model, rendering qualitatively similar results. We do not explore the potential game-theoretic ramifications of the manager-shareholder relation any further.

Therefore, even banks without any actual solvency or liquidity problems may behave differently from standard mean-variance portfolio optimizers. The banks for which the distance-to-termination effects in the utility are significant will be called *liquidity-sensitive* (LS). The opposite case will be dubbed *liquidity-insensitive* (LI).[24]

Next, we select a measure of parent-affiliate lending spillover in the chosen stylized two-period set-up. It is defined as the dependence of the lending volumes in the affiliate, *x*, on the mean return on loans in the parent, *Z*, and characterized described by a formula for the partial derivative $\frac{\partial x}{\partial Z}$. The latter is generically non-zero, i.e., some dependence of the affiliate credit creation on the home country loan performance is always present. i.e. in general, the MNB transmits shocks across the border. Depending on the sign of this transmission, one distinguishes between substitution ($\frac{\partial x}{\partial Z}$<0, shock inversion) and contagion ($\frac{\partial x}{\partial Z}$>0, shock propagation). To formulate the formal result, one needs some more notation.

By ω we denote the variance-covariance matrix of the MNB asset returns under delegated affiliate management, and by $\tilde{\omega}$ the analogous matrix under replacement direct management. It is natural to assume that $\tilde{\omega}$ is non-singular (i.e., under arm's length management, there are no redundant assets in the MNB portfolio); we denote by Ξ its inverse. There are three elements of those matrices that appear in the main result. Namely, the two (*x*,*x*)-elements of ω and $\tilde{\omega}$ are denoted by σ_l^2 (the variance of host country loan returns achieved by the delegated manager), and σ_s^2 (the variance of the replacement returns). Further, let *X* be the lending volume of the parent. The (*x*,*X*)-element of Ξ will be denoted by ξ_{xX}. Finally, let *R** be the vector of mean returns on outside assets, i.e., all but the home and host country loans *X* and *x*.

For the sake of subsequent inference of empirical hypotheses it is convenient to relate the $\frac{\partial x}{\partial Z}$ value in an MNB with the actions of other hypothetical international investors with a simplified structure. We consider two of those. The first is the frictionless investor defined in 3.1. The number of host country loan portfolio shares that would be optimally held by such an investor is denoted by x^u (which can be both positive and negative). The results discussed in the Appendix imply $\frac{\partial x^u}{\partial Z} = \frac{\xi_{xX}}{\gamma}$. The second type of investor is also a non-bank and has no termination boundary, but the management of the host country loans is delegated, with the same consequences for the asset return statistics as in the MNB. In particular, host country loans on average earn z^l as opposed to the z^s (z^s<z^l) earned under arm's length management. This investor optimally holds x^h shares of the host country loan portfolio.

The Appendix shows that there exist coefficients δ (a scalar) and Δ (a row vector of the same dimension as the column vector *R**), which are functions of matrices ω and $\tilde{\omega}$, such that

$$x^h = \frac{\sigma_s^2}{\sigma_l^2} x^u + \frac{z^l - z^s}{\gamma \sigma_l^2} + \delta Z + \Delta \cdot R^* . \quad (1)$$

This result means that when a frictionless international investor introduces delegation, the optimal host country loan holdings undergo several adjustments. First, the previously held quantity, x^u, is corrected by the variability ratio reflecting the relative riskiness of arm's length vs. delegated management. Second, the holdings are increased by the "Sharpe ratio increment" resulting from the average return improvement from z^s to z^l. Finally, there are two more hedging demand corrections which are present only under delegation, one generating an additional loading of the home country return factor, *Z*, and the other being the additional loading of the outside asset return factors, *R**. In general, the signs of the two last terms are ambiguous. Hypotheses about their typical values will be offered in 3.4.

Let us return to the MNB case. Denoting by *n* the standard normal density, put

$$\Pi = \frac{Xn(T)}{\sigma^2 V^2}\left[\gamma\big(N(T)T + n(T)\big)\left(1 + \frac{T}{\gamma\sigma}\right) - \frac{M}{\gamma\sigma}\right]$$

and define $\tilde{\Pi}$ analogously for the replacement variables. Π ($\tilde{\Pi}$) quickly declines to zero with growing distance to termination.The characterization of the equilibrium portfolio choices provided in the Appendix enables us to establish the following dependence of *x* on *Z*:

[24] We consider only a failure trigger for the bank as a whole, i.e., the affiliate has the status of a branch. This does not entail a loss of generality in our context: a separate trigger for the host country unit is of minor relevance since the majority shareholder (parent MNB) is supposed to (and usually would) inject capital into a troubled subsidiary. In fact, in our sample, overcapitalization of foreign subsidiaries prevails. Formally, the analysis of a subsidiary form would go along similar lines and, although the expected shareholder utility would be calculated differently, the qualitative nature of the results would not change.

$$\frac{\partial x}{\partial Z} = \frac{\sigma_s^2}{\gamma \sigma_l^2}\Theta \xi_{xX} - \frac{\Pi z^l - \tilde{\Pi} z^s}{\gamma \sigma_l^2} - \frac{\sigma_s^2}{\sigma_l^2}\tilde{\Pi} x^u + \left(\Theta - \tilde{\Pi} Z\right)\delta - \tilde{\Pi}\Delta \cdot R^* \quad (2)$$

This equation visualizes the structure of the home-host country lending spillover in a generic MNB in terms of the variables appearing in (1). Thus, one should read (2) as a simultaneous reflection of all the leverage and termination risk as well as delegation-induced modifications that cause the lending spillover in an MNB to deviate from this benchmark. In the first term, the MNB-specifics show up in the riskiness adjustment due to delegation, $\frac{\sigma_s^2}{\sigma_l^2}$, and the mean-variance tradeoff, Θ. The remaining terms create separate effects driven by managerial delegation and liquidity-sensitivity. All of them impact on the direction of the cross-border lending spillover (the sign of the right-hand side of (2)) compared to the frictionless baseline. There are two important special cases of (2). First, for an LI-bank, it is reduced to

$$\frac{\partial x}{\partial Z} = \frac{\sigma_s^2}{\gamma \sigma_l^2}\xi_{xX} + \delta . \quad (3)$$

Second, for an LS-bank without delegation (arm's length lending in the affiliate), (2) becomes

$$\frac{\partial \tilde{x}}{\partial Z} = \frac{\Theta}{\gamma}\xi_{xX} - \tilde{\Pi} x^u . \quad (4)$$

Equation (2) is a highly stylized comparative statics result with many unobservable variables and is not immediately testable. The signs of the terms on the right-hand sides of (2)–(4) cannot be directly derived from the model, either. To make plausible conjectures about them, one needs to put the model in a wider context of existing knowledge about financial institution operations in open economies.

3.4 Empirical implications

The first term in (2) is driven by the variance-covariance structure of the risk faced by the bank under replacement (arm's length) management of the affiliate. Its sign is determined by the inverse covariance matrix element ξ_{xX}, and is therefore unobservable. Nevertheless, we know that ξ_{xX} lies outside the main diagonal and should normally be small.[25] Its weight is further diminished by the mean-variance tradeoff factor Θ which falls to zero with increasing sensitivity to liquidity. Therefore, there are reasons to believe that, quantitatively, the first term is of a lower order than the remaining ones. In addition, we recall that factor ξ_{xX} is responsible for cross-border dependence in all internationally investing financial institutions regardless of institutional specifics: it is the only parameter that links parent return to affiliate lending volume in a frictionless mean-variance portfolio optimizing framework. Consequently, we associate the first term with a frictionless type of spillover driven by macroeconomic and financial fundamentals in the home and host countries. We assign this term the role of the channel through which these fundamentals will enter the subsequent empirical model as explanatory variables of the affiliate loan dynamics.

The second term of (2) originates in the Sharpe ratio improvement effect due to delegation (as discussed earlier for the non-bank investor). This term would normally act towards substitution (or winner-picking, i.e., funds go after higher returns). At first sight, one would expect the substitutionist cross-border spillover represented by this term to be dominant. Nevertheless, due to the corrective factors Π and $\tilde{\Pi}$ with which the mean returns z^l and z^s enter the Sharpe ratio, this term is non-negligible only in liquidity-sensitive banks. In addition, the delegated affiliate manager, who is able to increase the bank-wide distance to termination significantly, also reduces the weight of his excess earning ability (Π quickly falls below $\tilde{\Pi}$ as T becomes bigger than $\tilde{T}$), reverting the sign from plus to minus. Intuitively, due to a rapidly growing manager fee, there are decreasing marginal shareholder returns to managerial effort, so that the shareholder has little incentive to support the affiliate which already performs too well.[26]

[25] For instance, in the fairly unrealistic but conceptually important special case of fully uncorrelated loan portfolio and alternative asset returns, ξ_{xX} becomes proportional to $-\rho$, where ρ is the correlation coefficient between home and host country loan returns (since one can then isolate the 2x2 block in $\tilde{\omega}$ with off-the-diagonal elements being generated by ρ). One would expect the correlation ρ to be small unless there is a huge overlap in the home and host country borrower sets or, at least, highly synchronized business cycles. None of the two conditions holds for the home-host country pairs appearing in our sample, arguably because banks go abroad in order to diversify, not to acquire more of the same as at home. See, for example, García-Herrero and Vázquez (2007) for empirical evidence.

[26] Analogous effects under different quantitative set-ups can be found in other internal capital market models, e.g. Scharfstein and Stein (2000), Proposition 1, or Bernardo et al. (2006).

The third term reflects the sensitivity to the changes in Z of the mean-variance tradeoff factor Θ that appears in the MNB x-determination rule of LS-type (see the Appendix). The term is especially important for the lending spillover sign in situations where delegation effects are weak (i.e., the bank behavior can be approximately described by (4)). The sign of the term depends on the hypothetical frictionless investor position, x^u, in the host country loan portfolio. In the absence of short-sale constraints, this position can be both positive and negative. The term contains the liquidity-sensitivity factor $\tilde{\Pi}$, so that it vanishes quickly as the bank distances itself from the termination threshold. But even when the LS-effect is strong, one can point at conditions under which x^u should typically be negative (and, accordingly, the whole term should support contagionist behavior). In general, the fact that the optimal position of the frictionless investor in the host country loan portfolio is short ($x^u<0$) is tantamount to saying that this portfolio is overvalued with respect to the fundamental present value of its prospective earnings. In other words, it is too costly to increase the capacity of foreign operations. We believe this to be a plausible conjecture exactly for the period covered by our sample, characterized – on a global scale – by excess savings, yield search, and growing competition among financial intermediaries. As everyone was to learn later, the above factors were instrumental in driving asset prices above their fundamental value (the correction did not start until 2007). In the stylized environment of our model, this corresponds to x^u taking negative values. We therefore hypothesize that, by means of the 3rd term of (2) (or the 2nd of (4)), liquidity-sensitivity should contribute to contagionist behavior.

The fourth and fifth terms (boiling down to a single scalar δ for LI-banks; see (3)) are a consequence of delegation and are driven by the same parameters δ and Δ as the delegation-induced additional hedging x-demand by a non-bank. The sign of the fifth term (containing Δ) is ambiguous, and, due to the presence of factor $\tilde{\Pi}$, its importance declines quickly with the distance to termination. In general, the composition of this term provides a formal underpinning for interacting a bank-specific explanatory variable representing parent-affiliate frictions (the $\tilde{\Pi}$ part) with regressors that represent macro fundamentals (the $\Delta \cdot R^*$ part; see 4.2 for the interaction specification and the Appendix for the construction of Δ).

We are left with the fourth term, the only one which survives the disappearance of the distance-to-termination effects in an LI-bank. This component of (2) is a product of an LS-driven factor in parentheses, which is generically positive and converges to unity in LI-banks, and the coefficient δ coming from the covariance structure of the available assets.[27] In the model itself, there is no information leading to a prior hypothesis about the sign of δ. A guess can be made based on the rule (1) for the non-bank loan portfolio holdings. We see that $\delta>0$ if and only if the loading of the home country return factor in the additional hedging demand for x^h by a non-bank investor induced by delegated management is positive. We conjecture that this should typically be the case: the experience of many open economies suggests co-movement in overall financial deepening and credit growth on the one hand, and financial integration with advanced foreign economies (implying more cross-border diversification) and expanding capacity of foreign entities in the financial sector on the other. The latter usually implies an increased role of local managerial expertise.

The upshot of the above discussion is threefold. First, the model confirms that lending spillover is driven by both aggregate and bank-specific factors. Second, gains from delegation support substitution *ceteris paribus*; however, the effect is likely to dwindle with increasing liquidity-sensitivity of the parent. Third, substitution will typically give way to a contagionist outcome as internal capital market frictions in an MNB related to liquidity-sensitivity and, in the absence of that, manager delegation gain in importance. In the next section we incorporate this hypothesis into an empirical model of MNB affiliate lending dynamics.

4. Empirical evidence on MNB cross-border lending spillovers

4.1 Sample and definition of variables

We work with a set of 34 parent banks worldwide that operate foreign affiliates of some significance for either the host country or the banking group considered. To exclude cases of financial entrepreneurship in the bulk of emerging markets with elevated risk, we only consider affiliates in mature industrial and advanced emerging countries. MNB penetration into developing countries is influenced by too many unobservable factors (emerging market participations constitute a distinct segment of eligible investment opportunities; credit risk management and asset valuation are formally different from the ones applied in legally stable developed economies). Thus, parent banks that only expanded into emerging countries are not present in our sample. This selection did not lead to much loss in the parent bank sample

[27] Among other things, by tracking down the genesis of δ formally (see the Appendix), one can show that the exchange rate volatility typically works towards increasing the absolute value thereof.

(the major consequence was exclusion of several U.S. banks with affiliates in Latin America outside Mexico): most international banking groups maintain at least a branch in another OECD member state.[28]

Next, structural changes in the sample, such as mergers and acquisitions among both parents and affiliates, would inevitably grow quickly with the length of the period considered. Therefore, our sample is selected so as to minimize the incidence of mergers and acquisitions unless the data allow for easy aggregation. As a result, we had to sacrifice a portion of the temporal dimension of our panel in order to capture the most recent stable state of the MNB landscape in industrialized countries. This has resulted in a sample covering the years 1999–2004, when most of the dependent banks considered were in operation and belonged to a fixed international banking group in the set of parents. In addition, compliance with two criteria was used as a walking ticket into the parent bank and affiliate samples: (1) foreign affiliates had to occupy a non-negligible (our threshold is 3 percent) share in the total MNB assets, and (2) the affiliate had to have a tangible (over 3 percent) share in the host country loan market.[29] Finally, the parent company of an affiliate bank had to be a bank itself.[30]

Our set includes the top ten largest banks in the world in terms of total assets (as of 2005), among them Mitsubishi-UFJ Financial Group, Citigroup, Mizuho Financial Group, HSBC Holdings, BNP Paribas, Royal Bank of Scotland, and Bank of America. The complete list is given in Table 1. The sample of affiliates comprises 55 entities that operate in the following countries: Canada, the Czech Republic, Estonia, Hungary, Ireland, Korea, Latvia, Lithuania, Mexico, Poland, Portugal, Slovakia, Switzerland, Turkey, the United Kingdom, and the U.S.

To formulate a statistically verifiable decomposition of MNB affiliate lending dynamics based on our theoretical findings, one needs not only a set of explanatory variables for the home and host returns on loan portfolios, but also an operational measure of shareholder-manager frictions. To this end, we used the available MNB balance sheet data to construct an *Affiliate Friction Indicator* (AFI), reflecting the degree of presumed manager delegation and/or liquidity-sensitivity. The AFI is, in practice, a zero-one dummy formed by checking the validity of two conditions. The *delegation indicator* (DI) was assigned the value of unity if at least one of its affiliates had a significant local loan market share (a loan volume higher than 30 percent of the leading host country lender) and zero otherwise. The *liquidity-sensitivity* indicator (LS) was set to unity if the parent MNB had a capital ratio not too much in excess of the regulatory limit (our cut-off value is 12 percent) and zero otherwise. Then, in view of the adopted interpretation of our theoretical findings (both liquidity-sensitivity and delegation friction independently contribute to the same direction of cross-border spillover; see Subsection 3.4), the AFI should be equal to one if either the DI or the LS is equal to one.

The local loan market share criterion was used since it seems rational to assume that an MNB cannot manage a significant share of the commercial lending business on a purely arm's length basis.[31] As for the role of the capital ratio, tight economic and prudential capital figures should indicate that the bank grants loans without spare risk-cushions, i.e., closer to the hypothetical exogenous intervention boundary than banks with slack constraints. Both indicators – the affiliate's local loan market share and the capital ratio – are quite stable during our sample period, so that we obtained an average number well characterizing the whole analyzed period.[32]

Recalling the theoretical model of the previous section, we can tag the banks with AFI = 1 as "contagionist" and the others as "substitutionist." The AFI values for our sample of parent MNBs are shown in Table 1.

In order to capture the host (affiliate's) and home (parent's) country macroeconomic conditions, we used data on GDP growth, real (inflation-adjusted) long-term yields on government bonds, and the exchange rate volatility between the parent bank country currency and the affiliate's host country currency. The exchange rate volatility was measured as a standard deviation of the monthly average growth rates of the exchange rate from its average annual

[28] One can compare, for example, with de Haas and van Lelyveld (2006b), who work without this restriction and have a longer time horizon, but whose MNB sample size is not much bigger than ours.

[29] We decided against including affiliates with a tiny market share, given that such banks usually service a very specific non-representative group of clients. Also excluded were affiliates in international financial centers (Cyprus, Hong Kong, Luxembourg, etc.), in view of their weak connection with the real economy of the host country.

[30] To this effect, note the presence of Merrill Lynch in our sample, as opposed to other major international investment banks. The reason is that, unlike its better known holding company, Merrill Lynch International Bank in the set of affiliates is a commercial bank.

[31] This criterion happens to nearly coincide with the one based on the origin, i.e., an affiliate started from scratch vs. takeover of a pre-existing bank. The latter, without exception, were prominent local players at the time of acquisition.

[32] It did not seem justifiable to introduce any additional criteria, such as the balance sheet size of the affiliate relative to the parent, since they did not change anything in the classification obtained. Particularly, relative affiliate size is closely correlated with local market share. This would be different if one took into account small international private banks; however, such banks neither could (lack of data) nor should (specific client base and loose relation with general economic conditions) be considered here.

growth rate.[33] In this way we focus on the role of short-term exchange rate uncertainty in the lending growth decisions.

In addition, we chose two affiliate characteristics to control for the affiliate's specific credit creation drivers. Those characteristics are return on assets (ROA) and the ratio of loan loss reserves to total loans. To measure the parent bank cost of managing home credit risk we selected the parent bank's ratio of loan loss reserves to total loans. The data were taken from BankScope.[34] Their descriptive statistics are presented in Table 2.

As is apparent from the descriptive statistics, credit creation on the subsidiary level evolved quite dynamically, with the mean growth of total loans reaching approximately 16 percent, with very high variance. The ratio of loan loss reserves to total loans attained an average of 2.6 percent and varied by 1.4 percent. Generally, the indicators considered for the host countries, along with having higher average values, are more volatile than those for the home countries. This is consistent with higher returns in host countries compensated by higher uncertainty.

4.2 Estimation

We carried out a fixed-effects estimation with a first-order autoregressive process for residuals[35] on panel data structured according to the affiliate and clustered residuals at the parent bank level. Thus, the dependent variable is the growth rate of total loans of the affiliate and the fixed effects represent autonomous credit creation factors at the affiliate level. In order to test the hypothesis that parent-affiliate frictions influence cross-border lending spillovers, we used the loan loss reserves of the parent bank and that same variable multiplied by the interaction variable equal to the AFI. Hence, by comparing the sign and significance of both variables, we can assess the effect of affiliate frictions. We further control for other relevant variables as listed in Table 2.

Two regressions were run, a Baseline and an Alternative. Even though the regressions are nested so that one can discriminate between them on the basis of the explained variability, we present both to facilitate comparison with other studies. Whereas in the Baseline we take GDP growth as a proxy for economic activity, in the Alternative we replace it with the real long-term interest rate. In both regressions we interacted the chosen measure of economic activity (home and host) with the AFI indicator in order to test for an extra effect due to friction-dependent spillover. Last but not least, the AFI is interacted with the parent's measure of credit risk costs. The specification of the Baseline regression is formally written as

[33] This measure excludes the long-term trend element of the exchange rate behavior, against which, as we presume, MNBs are able to protect themselves at a low cost (this also excludes cases of predictable policy-driven trends as in crawling peg regimes, e.g. in Hungary and Poland).

[34] One of the technical factors restricting the choice of possible variables in a study like this is the availability of an indicator for all the financial institutions considered. ROA and loan loss reserves are among the few that can be found in BankScope for all the banks in our sample. The use of ROA is not unique to the present study: see e.g. García-Herrero and Vázquez (2007), who employ this indicator to analyze the diversification gains of international banks.

[35] Application of the Arellano-Bond (1991) dynamic panel data estimator never confirmed a significant lagged dependent variable. Hence, in order to address the possible serial correlation of the residuals, the fixed-effects estimator was amended with a first-order autoregressive process for the residuals.

$$l_{i,t} = \alpha_i + \beta_1 gdp_t^{HM} + \beta_2 gdp_t^{HST} + \beta_3 (gdp_t^{HM} * AFI_i) + \beta_4 (gdp_t^{HST} * AFI_i) + \gamma\sigma_t^{ER} + \delta_1 (AFI_i * LLR_{i,t}^P) + \delta_2 LLR_{i,t}^P + \theta_1 LLR_{i,t} + \theta_2 ROA_{i,t} + \varepsilon_{i,t} \quad (5)$$

Similarly, the Alternative specification reads as

$$l_{i,t} = \alpha_i + \phi_1 rir_t^{HM} + \phi_2 rir_t^{HST} + \phi_3 (rir_t^{HM} * AFI_i) + \phi_4 (rir_t^{HST} * AFI_i) + \gamma\sigma_t^{ER} + \delta_1 (AFI_i * LLR_{i,t}^P) + \delta_2 LLR_{i,t}^P + \theta_1 LLR_{i,t} + \theta_2 ROA_{i,t} + \varepsilon_{i,t} \quad (6)$$

Here, l is the growth rate of the volume of loans granted, α_i is the fixed effect of affiliate i, and gdp^{HM} and gdp^{HST} represent the home and host country GDP growth rates. By *rir* we denote the real long-term interest rate (host or home), and σ^{ER} denotes our volatility measure for the exchange rate between home and host country. ROA is the return on assets of the affiliate bank. Finally, *LLR* and LLR^P denote the ratio of loan loss reserves to total loans in the affiliate and the affiliate's parent bank, respectively. Term ε stands for i.i.d. disturbances and β, γ, δ, θ, and ϕ are the estimated coefficients.

The estimation results are displayed in Table 3. The choice of the fixed-effects model vs. random effects is supported by the Hausman test at the 1% significance level. We decided against a dynamic specification, as the serial autocorrelation in the error terms turned out to be very low (around 0.15). Besides, estimates using the Arellano-Bond (1991) procedure never confirmed a significant lagged dependent variable.

Based on the theory of Section 3, we expect a strong significant effect of parent-affiliate frictions to be manifested primarily in coefficients δ_1 and δ_2 responsible for bank-specific lending spillovers. Namely, if our conjecture about the frictions being supportive of contagionist shock transmission is correct, one should obtain a significant positive value of δ_2 (MNBs with large capital cushions and arm's length management of affiliates tend to be substitutionist) and a significant negative value of $\delta_1+\delta_2$ (contagionist effects dominate in banks with tight capital ratios and/or delegated management of affiliates). And this is, indeed, what we have obtained in both the Baseline and the Alternative (Table 3). Although our model predicts the same frictions to interact with systemic risks as well, it assigns the resulting synergies a lower weight and allows the sign of their impact to vary (see the discussion in 3.4). Therefore, we consider the "right" signs, magnitudes, and significance of the estimated δ_1 and δ_2 to be central to the verification of our empirical prior.

The home country factors turn out to be relatively unimportant, except for GDP growth in the case of contagionist parent banks. Accordingly, a one percent increase in GDP growth in the home country spills over into a host country acceleration of growth of loans by 1.78 percent only in the case of contagionist banks. This may seem to contradict earlier empirical studies of foreign bank lending dependence on home country growth (e.g. de Haas and van Lelyveld, 2006b). However, these studies, unlike the present one, rely on cruder econometrics without micro guidance. So, unlike our specifications (5) and (6), they do not take the possibility of parent-specific interaction between home conditions and affiliate credit growth into account. Our approach offers a refinement in which the home country real fundamentals are co-channeled into affiliate behavior through parent-level factors such as credit risk costs (*LLR*).

On the contrary, the host country current and expected economic conditions (GDP growth and alternatively the real long-term interest rate) appear to be important determinants of local credit growth. In particular, a one percent increase in host country GDP growth (alternatively, the real long-term interest rate) increases loan growth by 2.3 (5.8) percent. The results for the baseline specification are consistent with previous results obtained by, for example, de Haas and van Lelyveld (2004, 2006b) and Barajas and Steiner (2002). While de Haas and van Lelyveld (2006b), who studied a similar sample of international banks and affiliates, find the elasticity of the host GDP to be around 2 percent (an average over six basic estimations – Table 2, page 14), Barajas and Steiner (2002) studied credit demand and supply in Colombia and found a similar result for the host GDP growth (elasticity of 2.1 percent). Thus, our estimated sensitivity of 2.3 percent is quite close to the previous evidence.

On the whole, we find that the Alternative outperforms the Baseline, e.g. in terms of a higher R^2: the explained variability in loan dynamics is twice as high. We believe that this is the case because the long-term real interest rate as a proxy for (expected) real activity is more relevant for bank decisions than GDP growth. As it is closely linked to the banks' expectations about future returns, the long-term real interest rate is likely to be strongly associated with the credit conditions and loan dynamics.

Further, a one percent increase in exchange rate volatility reduces credit creation by roughly 7 percent (in the dominating Alternative regression). The exchange rate rarely plays a role in the available studies. In our estimations, it is insignificant in the Baseline but significant in the Alternative. We conjecture that the reason is a more appropriate specification of financial factors (long-term real interest rates) in the Alternative regression.

Among the affiliate bank specific variables, only loan loss reserves turned out to be significant; their one percent increase reduces credit growth by 2.4 percent. Finally, when testing the effect of the loan loss reserves of the parent bank on credit growth in its affiliate, we found a statistically significant relation. In particular, affiliate banks with a low presumed parent-affiliate friction (as we define it), experience an increase in credit growth when the parent bank faces increased credit risk (a substitution effect). Quantitatively, a one percentage point increase in the loan loss reserves ratio of the parent bank increases credit growth by 20 percent. On the contrary, affiliate banks that were assigned a high parent-affiliate friction indicator experience a reduction (by 16 percent) in credit growth (a contagion effect) as a result of a one percentage point increase in the loan loss reserves ratio of the parent bank. This fact seems to be good confirmation of our prior about the direction given to cross-border lending spillover by the frictions inherent in the MNB-internal capital markets. We have conjectured that this direction should be towards contagion for the period and the countries characterized by increasing financial integration, yield search by foreign investors, and overpricing of local assets. The sign of the spillover restricted by the use of the Affiliate Friction Indicator in the empirical specification bears out this hypothesis.

Conclusions

This paper investigated the reaction of a foreign affiliate to an asset return shock in the home country. To this end, we introduced a model of a multinational bank with delegated foreign affiliate management and compared its reaction to a home country shock with that of a bank acting as an arm's-length investor. Our analysis exploits the notion of the hypothetical replacement decision-making of a bank shareholder in the case where she decides to do without the manager's skills and save on his fees. These portfolio decisions are different from the actual lending decisions of the manager, who tries to stay marginally more attractive to the shareholder than her own replacement management of the affiliate. Since the manager's fee derives from his ability to outperform the shareholder's replacement earnings, the lending volume is influenced by variables outside the affiliate. So, formally, although the investment opportunity set of the manager is limited to host country lending, his decisions are exposed to global influences. This agency phenomenon produces cross-border parent-affiliate lending spillovers. We want to know whether they go in the direction of shock-suppression, when funds go to the MNB division with superior returns (substitution), or shock-amplification, when the affiliate lending follows the sign of the parent's performance (contagion). The model predicts that two MNB-internal capital market frictions, associated with liquidity-sensitivity and affiliate management delegation, are likely to support the contagionist type of cross-border lending spillover, especially under inflated asset prices in the host countries where MNB affiliates operate.

This proposition was tested in an empirical model in which more traditional macroeconomic and financial control variables were expanded to include a binary variable (Affiliate Friction Indicator) that captured the extent of the said frictions in an MNB. The panel regression, conducted on a sample of 34 multinational banks, showed a significant influence of parent bank performance on affiliate lending, after controlling for aggregate variables. As expected, this influence becomes significant when the friction indicator is used to constrain its sign. In other words, cross-border lending spillover in international banks is not unidirectional; it takes the form of either lending contagion or substitution depending on the extent to which the MNB is subject to liquidity constraints and the influence of local managers on lending in affiliates.

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Appendix: Formal aspects of the delegated MNB affiliate management model

Model variables and equilibrium

Let B, D, X^0, and X be, respectively, shareholder own funds (capital), deposits, cash holdings, and loans granted for the parent bank, and the corresponding lowercase letters stand for the same things in the affiliate. Deposit volumes, D and d, as well as the total funds available for investment in the MNB, C, are given exogenously. If A are funds invested in alternative assets, then $C=A+B+b$. The rate of return R^A on outside assets is the opportunity cost of bank capital. Loans earn a risky rate of return R^L, cash earns the risk-free interest rate R^0, deposits pay interest R^D, and the random deposit/withdrawal rate at date 1 is L. Let $Y^L=R^L-R^0$, $Y^D=1+R^0-R^D-L$, $Y^A=R^A-R^0$ be the excess returns on loans, deposits, and outside assets over the risk-free rate (same in lowercase for the affiliate).[36] Given the balance-sheet identities $B+D=X^0+X$ and $b+d=x^0+x$ for the home and foreign parts of the bank, the period-1 domestic disposable wealth, i.e., the funds of the bank shareholder net of the opportunity cost of capital, is equal to

$$W^H = X^0(1+R^0)+X(1+R^L)-D(R^D+L)-B(1+R^A)=XY^L+DY^D-BY^A$$

and the disposable funds in the affiliate are equal to $w=xy^l+dy^d-by^a$.

The shareholder gross funds at date 1 coming from both bank branches is $W^S=W^H+(1+\tau)w-f$, where τ is the rate of the host country currency appreciation between periods 0 and 1, and f is the manager fee. Denoting by $y^{*l}=(1+\tau)y^l$, $y^{*d}=(1+\tau)y^d$, $y^{*a}=(1+\tau)y^a$ the excess returns in the home country units, we can summarize the period-1 funds of the shareholder by the expression

$$W=XY^L+DY^D-BY^A+xy^{*l}+dy^{*d}-by^{*a}+C(1+R^A)-f \cdot \tag{A1}$$

To reduce the problem to the case where lending in the home country part of the bank is managed directly, the home country bank variables can be considered summary statistics of the management structure in which its own delegation takes place. The introduction of a separate delegation problem in the home country would increase the model complexity without changing the qualitative results.

If the manager is not hired, the shareholder replacement wealth $\tilde{W}$ is obtained from (A1) by replacing xy^{*l} with $\tilde{x}y^{*s}$ and setting f=0.

Thus, the strategy space of the shareholder is parameterized by vector $\tilde{I}=\left[\tilde{x},I^S\right]=\left[\tilde{x},X,-B,-b\right]$, whereas that of the manager is parameterized by vector $[x,f]$. Assumption 1 means that the equilibrium fee which the manager is able to negotiate is implicitly characterized by the equality

$$U\left(x,I^S,f\right)=\tilde{U}(\tilde{I}). \tag{A2}$$

The solution for $f=F\left(x,\tilde{I}\right)$ following from the Implicit Function Theorem is unique due to the strict concavity of the utility functions U and $\tilde{U}$. Naturally, of all the combinations (x,f) that satisfy (A2), the manager chooses the one with the highest f.

The equilibrium outcome of the shareholder-manager bargaining game is defined as a pair $\left(\tilde{x},J\right)$ of scalar $\tilde{x}$ and vector $J=[x,X,-B,-b,D,d,C]^T=[I, I^0]^T=[x,I^S, I^0]^T$ in which, given the levels $I^0=[D,d,C]^T$ of exogenous balance sheet items,

- x maximizes the manager's fee defined by condition (A2), given the shareholder's choice of I^S
- $\tilde{I}=\left[\tilde{x},I^S\right]^T=\left[\tilde{x},X,-B,-b\right]^T$ maximizes the shareholder's replacement expected utility.

The shareholder, who will effectively attain replacement utility $\tilde{U}$ anyway, decides rationally upon the X-, $\tilde{x}$-, B-, and b-levels as if counting on a negative negotiation outcome with the manager, meaning that she selects $\tilde{I}$ which maximizes $\tilde{U}$. Clearly, $\tilde{I}$ does not depend on the manager-selected loan volume x (because $\tilde{U}$ does not). The strict concavity of $\tilde{U}$ implies $\frac{\partial\tilde{U}}{\partial\tilde{I}}=0$ for the optimal choice.

The selection of x by the manager is made so that $f=F\left(x,\tilde{I}\right)$ is maximized given $\tilde{I}$. Since fee negotiation results in (A2) for any choices of x, (A2) is an identity along the x-dimension. By taking its partial x-derivative, one

[36] *If all deposits were claimed back at date 1, we would have* L=*1 and* $Y^D=R^0-R^D$. *However, we deal with a typical case where only a fraction of the deposits is withdrawn, so that* L *is a random variable distributed around a mean value substantially below unity.*

gets $\frac{\partial U}{\partial x} + \frac{\partial U}{\partial f}\frac{\partial F}{\partial x} = 0$. Thanks to the strict concavity of U, F has a single maximum w.r.t. x for every value of $\tilde{I}$, and this maximum is given by the first-order condition $\frac{\partial F}{\partial x} = 0$. Thus, the usual Envelope Theorem argument demonstrates also that $\frac{\partial U}{\partial x} = 0$ in equilibrium. Given the equilibrium choice of $\tilde{I}$, the manager's choice of x is also utility-maximizing for the bank shareholder as long as the bank is not too close to failure. The above arguments can be summarized as

Proposition A1 *For sufficiently liquid banks (distance to failure T is big enough so that shareholder utility U is growing in the mean of disposable wealth and decreasing in its variance), the manager's equilibrium choice of lending volume in the affiliate maximizes the shareholder's utility given her equilibrium replacement choice of portfolio. The maximum is unique and is given by the internal solution to the first-order condition* $\frac{\partial U}{\partial x} = 0$.

The mechanics of lending spillover

Below, we sketch the formal derivation of the MNB's investment decisions and the parent-affiliate lending spillovers implied by them (i.e., equations (1)–(4)), in an environment of multivariate normal distribution of excess returns.

Assumption A1 (Exogenous risk distribution) *Random variables* Y^L, Y^D, y^{*l}, $\tilde{y}^{*s}$, $y*^d$, Y^A, *and* $y*^a$ *are jointly normally distributed.*[37]

Let us denote the means of the excess returns listed above by Z, Z^D, z^l, z^s, z^{*d}, Z^A, and $z*^a$, then

$$\mu = XZ + DZ^D - BZ^A + xz^{*l} + dz^{*d} - bz^{*a} + C(1 + r^0 + Z^A) - f,$$

and $\tilde{\mu}$ can be obtained from μ by replacing xz^l with $\tilde{x}z^s$.

Condition (A2) defines the fee f implicitly as a function of the manager's own loan volume choice x and the vector of the shareholder's replacement portfolio holdings $\tilde{J} = [X,D,B,\tilde{x},d,b,C]^T$. In the range of bank wealth values relevant for our analysis (i.e., not too close to failure) both x and $\tilde{J}$ are given by internal solutions to the manager's and the shareholder's optimization problems, respectively. In other words, they satisfy the first-order conditions of optimality to be spelled out below.

Let Ω be the covariance matrix of the random vector $[Y^L,Y^D,-Y^A, y^{*l},y^{*d},-y*^a,Y^A]$. Matrix $\tilde{\Omega}$ is defined analogously. We split them into blocks corresponding to the partition $[I,I^0]^T$ of J into endogenous and exogenous balance sheet items and also introduce a decomposition of matrix $\Xi = \tilde{\omega}^{-1}$ so as to separate the x-row and the X-column:

$$\Omega = \begin{bmatrix} \omega & \Psi \\ \Psi^T & \Lambda \end{bmatrix}, \ \tilde{\Omega} = \begin{bmatrix} \tilde{\omega} & \tilde{\Psi} \\ \tilde{\Psi}^T & \Lambda \end{bmatrix},$$

$$\tilde{\omega}^{-1} = \Xi = \begin{bmatrix} \xi^x \\ \Xi' \end{bmatrix} = \begin{bmatrix} \xi_{xX} & \xi'^x \\ \xi'_X & \xi \end{bmatrix}.$$

One can check that the mean and variance sensitivities of the shareholder utility are equal to $M = \gamma N(T) - \frac{n(T)}{\sigma}$, $V = \gamma N(T) - \left(2 + \frac{T}{\gamma\sigma}\right)\frac{n(T)}{\sigma}$ (similarly for replacement utility sensitivities). Put $\tilde{R} = \left[z^s, R^*\right]^T$ – the vector of mean asset returns in the shareholder's replacement portfolio. Using the equalities $\frac{\partial U}{\partial x} = e^{-\gamma CE}\left(Mz^l - V\gamma\Omega^x J\right)$ and $\frac{\partial \tilde{U}}{\partial \tilde{I}} = e^{-\gamma \tilde{CE}}\left[M\tilde{R} - V\gamma\left(\tilde{\omega}\cdot\tilde{I} + \tilde{\Psi}\cdot I^0\right)\right]$ (this can be checked directly), one obtains the optimal portfolio choices of the bank with and without delegation:

$$V\gamma\Omega^x J = Mz^l, \tag{A3}$$

$$\tilde{V}\gamma\left(\tilde{\omega}\cdot\tilde{I} + \tilde{\Psi}\cdot I^0\right) = \tilde{M}\tilde{R}. \tag{A4}$$

In the special case of an LI-bank the ratio M/V would be almost unity and (A3) would correspond to optimizing the certainty equivalence CE with respect to x, as with any other liquidity-unconstrained optimizing investor. For the same

[37] *If the exchange rate uncertainty were modeled separately, the normality of excess returns* y^{*a}, y^{*d}, *and* y^{*l} *would not be the most natural assumption. However, a more realistic representation of the exchange rate risks would lead to more complex calculations without affecting the qualitative implications of the model.*

reason, the portfolio selection decisions of a non-bank, a liquidity-unconstrained investor described by the special case of (A3), imply (1).

It remains to calculate the *Z*-sensitivity for vector *I* and the component I^S of $\tilde{I} = \left[\tilde{x}, I^S\right]^T$. The results, which follow from differentiating (A3) and (A4) w.r.t. *Z*, are

$$\omega^x \frac{\partial I}{\partial Z} = \sigma_l^2 \frac{\partial x}{\partial Z} + \omega'^x \frac{\partial I^S}{\partial Z} = \frac{Xn(T)}{\gamma\sigma^2 V^2}\left[\frac{M}{\gamma\sigma} - \gamma\left(N(T)T + n(T)\right)\left(1 + \frac{T}{\gamma\sigma}\right)\right] z^l \quad , \tag{A5}$$

$$\frac{\partial I^S}{\partial Z} = \frac{Xn(\tilde{T})}{\gamma\tilde{\sigma}^2\tilde{V}^2}\left[\frac{\tilde{M}}{\gamma\tilde{\sigma}} - \gamma\left(N(\tilde{T})\tilde{T} + n(\tilde{T})\right)\left(1 + \frac{\tilde{T}}{\gamma\tilde{\sigma}}\right)\right]\Xi \cdot \tilde{R} + \frac{\tilde{M}}{\gamma\tilde{V}}\xi'_X \quad . \tag{A6}$$

In (A5), ω'^x is the row vector of covariances between ε^{*l} and ε^S=[ε^L,- ε^A, ,-ε^{*a}]. Combining (A5) with (A6) and recalling the definitions of Π, $\tilde{\Pi}$, and Θ, one arrives at

$$\frac{\partial x}{\partial Z} = -\frac{\Theta}{\gamma\sigma_l^2}\omega'^x \cdot \xi'_X + \frac{1}{\gamma\sigma_l^2}\tilde{\Pi}\omega'^x \cdot \Xi' \cdot \tilde{R} - \frac{1}{\gamma\sigma_l^2}\Pi z^l \cdot \tag{A7}$$

Equation (A7) transforms into (2) when one uses the inverse matrix definition and employs the notation $\delta = \frac{\left(\tilde{\omega}'^x - \omega'^x\right) \cdot \xi'_X}{\gamma\sigma_l^2}$, $\Delta = \frac{\left(\tilde{\omega}'^x - \omega'^x\right)\xi}{\gamma\sigma_l^2}$.

Note that the *Z*-derivative of the lending volume x^h for the non-bank investor, which can be obtained by differentiating (1), is formally the same as the special case of (A7) for an LI-bank (and equivalent to (3)), since the preferences of all liquidity-unconstrained investors in our model are linear-quadratic. However, due to the existence of deposits on the bank balance sheet both its investment opportunity set is more complex and the resulting equilibrium lending volume is different from x^h, even if the bank is liquidity-insensitive. Naturally, when liquidity-sensitivity is added, the deposit-related uncertainty creates additional variation in the bank utility and drives *x* and x^h even further apart.

Table 1. List of parent banks

No		AFI	No		AFI
1	ABN-Amro	0	18	Crédit Lyonnais	0
2	Allied Irish Banks	1	19	Deutsche Bank	1
3	American Express Company	0	20	Erste Bank	1
4	Banca Intesa	1	21	Föreningssparbanken – Swedbank	0
5	Banco Bilbao Vizcaya Argentaria	1	22	GE Capital Itl Financing Corp.	0
6	Banco Comercial Portugues	1	23	HSBC Holdings	1
7	Banco de Sabadell	0	24	ING Groep	1
8	Banco Santander Central	0	25	MBNA Corporation	0
9	Bank of America Corporation	1	26	Merrill Lynch & Co.	0
10	Bank of Ireland	0	27	Mitsubishi Tokyo Financial Group	0
11	Royal Bank of Scotland	1	28	Mizuho Corporate Bank	0
12	Barclays Bank	0	29	National Australia Bank	1
13	Bayerische Hypo und Vereinsbank	1	30	Raiffeisen-Holding NÖ-Wien	1
14	BNP Paribas	1	31	Skandinaviska Enskilda Banken	1
15	CERA (KBC)	1	32	Société Générale	1
16	Citigroup	1	33	UBS	0
17	Commerzbank	1	34	Unicredito Italiano	1

Note: AFI=Affiliate Friction Indicator

Table 2. Descriptive statistics

	Mean	Std. dev.	Min	Max
Affiliate bank				
Growth of total loans	15.8	24.6	-56.7	90.5
Loan loss reserves to total loans	1.2	2.1	0	9.9
ROA	0.95	1.2	-6.4	5.6
Parent bank				
Loan loss reserves to total loans	2.6	1.4	0.0	7.1
Exchange rate volatility	0.99	0.73	0.0	4.58
GDP growth				
home country	2.5	1.96	-1.1	11.1
host country	3.5	2.4	-1.7	11.1
Inflation				
home country	2.1	1.2	-0.9	5.8
host country	3.8	4.3	-1.1	45.2
Long-term interest rate				
home country	4.7	0.9	0.9	6.3
host country	7.2	5.4	0.0	61.6

Note: Data in percent.

Table 3. Results of fixed-effects estimation with AR(1)

	Baseline	Alternative
Intercept [a)]	22.2(16.8)	20.9(19.7)
Host country		
Long-term real interest rate		**5.8**(2.3)**
Long-term real interest rate * AFI dummy		1.26(1.97)
GDP growth	**2.3**(1.2)**	
GDP growth * AFI dummy	-0.21(1.25)	
Home country		
Long-term real interest rate		0.49(4.4)
Long-term real interest rate * AFI dummy		-0.94(0.7)
GDP growth	-3.2(2.8)	
GDP growth * AFI dummy	**1.78**(0.79)**	
Exchange rate volatility	-2.5(4.4)	**-7.3*(4.13)**
Affiliate bank		
Affiliate bank's ROA	-1.56(3.1)	-0.79(2.9)
Affiliate bank's LLR	**-3.49*(1.89)**	**-2.4*(1.4)**
Parent bank		
Parent bank's LLR	**19.2***(7.3)**	**19.7***(7.2)**
Parent bank's LLR * AFI dummy	**-29.8***(10.7)**	**-34.7***(10.5)**
R^2	0.15	0.3
ρ	0.16	0.14
Corr(u_i,Xb)	-0.85	-0.89
Hausman test (Fixed vs. Random effects)	χ^2(9)=39.9***(0.00)	χ^2(9)=26.8***(0.00)

Notes:

a) The intercept represents the average over the set of fixed effects.

1. The dependent variable is the affiliate's growth rate of total loans;
2. Annual data with time span 1999–2004; 178 observations; 55 affiliate banks and 34 parent banks; standard errors in parenthesis; stars denote significance level: ***1%, **5%, *10%.
3. Residuals were clustered according to parent banks.
4. Estimation with the Arellano-Bond dynamic panel data estimator did not confirm a significant lagged dependent variable. Therefore, in order to address the possible serial correlation of the residuals the fixed-effects estimator was amended with a first-order autoregressive process of residuals.